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AUTHOR Beck, John J., Jr.
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ABSTRACT

A discussion on the impact of the information explosion on society provides the context for this paper's examination of procedures for designing the first stage of a systematic plan to incorporate computer technologies in elementary and secondary schools. Based on the rationale that a computer literate faculty must be available to make decisions on effective computer use, the paper discusses the roles that teachers and computers will play in educating students in the 21st century. Citing the need to match instructional and learner objectives, a paradigm for training teachers to be computer literate is recommended as the initial step in achieving that goal. Categories outlined for this initial introduction include information systems, information collection and retrieval, communications with a computer, computers in the marketplace, and computers in education. Suggested activities for generating additional competencies would include programs on: (1) the automatic control of processes, (2) the concept of input-process-output, (3) coding systems, (4) preparation of input and interpretation of output, (5) using computer program packages, and (6) hardware and software in context. Sixteen references are cited. (HER)

Computer Literacy for Elementary and Secondary Teachers

John J. Beck, Jr., Ph.D.

Department of Education

Southwest Texas State University, San Marcos, Texas

Computer Literacy for Elementary and Secondary Teachers

Among the several issues confronting us as we approach the end of the 20th century is the curricular issue of essentialism, the cry for back-to-the-basics, vs, the well-rounded or liberal approach to education. As the proponents of each side vie for position, future-oriented curriculum planners find increasing resistance to change from both sides. This current conservative mood among educators as well as society in general has stacked the deck against an early solution to what many see as the next great crisis in American education, that of computer literacy (Molnar, 1978). Recently Arthur Luehrman, computer research director of the University of California Lawrence Hall of Science emphasized this crisis by saying that "we will need 40-million persons able to use computers by 1990 and I don't know who is going to teach them"(Computer Illiteracy cited, 1980).

Man and Technology in the 21st Century

While technology has resulted in many conveniences, it has at the same time tended to make humankind's life more complex, and one evident indicator of this increasing complexity is the amount of information available for us to process. We have been witness to a manifold growth in available information, and our traditional processing techniques are proving to be inadequate and insufficient.

The field of science offers a vivid clue to the monumental mass of information available to us today. A study by the National Science Foundation revealed that currently over 100,000 scientific and technological periodicals are published each year in the world, and six to seven thousand

scientific articles of various kinds are produced each day. Equally astounding are the figures that show the number of articles being produced is increasing at a rate of fourteen percent a year(Molnar, 1978).

If we accept the data from the field of science as typical of other fields of human endeavor which are touched by technology, then it is justifiable to argue that information has become a national commodity and may very well have changed forever the nature of work. Molnar(1978), among others, now believes that we are at the apex of a transition from an industrial society to one of information processing.

An examination of technologies from both an analytical and a historical point of view reveals some interesting and seemingly relevant information. If we analyze such technologies as the printing press, aviation, or television, some curious generalizations may be made. We tend, for example, to overestimate the short-range impact of new technologies while at the same time we underestimate their long-range effects. Also, it appears that technologies do not develop independently of each other, but rather, in concert with others. And, too, the potential for the technology appears to be closely related to man's willingness to invest in it(McIsaac, 1979).

If we trace the historical development of various technologies, we find that from twenty-five to fifty years elapses from the development of the first prototype to widespread commercial use. Fifty-five years elapsed, for example, between the printing of Gutenberg's bible in 1455 to the time when printing shops were located in every major European city in 1500; thirty years elapsed from Morse's invention of the telegraph in 1836 to the laying of the first transatlantic cable in 1866; twenty-seven years elapsed from Zworykin's patent of the iconoscope in 1923 to widespread use of black and white television receivers in 1940; and twenty-two years

elapsed from Goldmark's rotating filter concept of color television in 1940 to RCA's first profitable year on color television in 1962(Nievergelt, 1980). Thus, it takes some time for a new technology to gain widespread use, and while the use of computers in the marketplace is extensive, our scant two decades of computer usage in education may simply be called a period of adolescence for the new technology.

Technology and Education

One of the strange ironies of life is that educators, those who are preparing people to live in the future, are the last segment of society to use new technologies. Teachers, frequently poorly informed or not informed at all, become bewildered by and disinterested in new technologies. This state of affairs is disconcerting to many because of the role we expect education to play. We can build a solid case to support the position that teachers are the only people with the right and responsibility to teach our youth to be better prepared for the future. If we do not support such a position, then we run the risk of placing the power of technologies in the hands of a few, and these few will assuredly be outside of education.

Today's schools are faced with difficult decisions, and with an ever increasing rate the major needs in our schools are becoming inexorably intertwined with declining enrollments, increasing costs, ineffective support for teachers, and back-to-the-basics attitudes. Within this context, where these issues are gaining the most attention, we are now being forced to consider the influence of technology, specifically computers, as a basis for our educational needs. Logically, this new need is justifiable. Consider that only a scant seven years after the marketing of hand-held

calculators, the world's largest producer of slide rules discontinued production(Molnar, 1978). Such a rapid concession to technology should tend to change our pricrities in schools. Given the necessary understanding and acceptance of computers, their use to improve our ability to process and retrieve information may be our best alternative as we seek answers to current and future school needs. Furthermore, traditional approaches to curriculum and instruction need to be examined continually. We cannot afford to use valuable time on obsolete functions. As Molnar(1978) has said,

> Computers and even hand calculators have made obsolete many subjects and have relegated the calculation of square root, logarithms, and fractions in education to the level of importance of dipping candles and tanning hides.

As we, who are involved with and concerned about our schools, strive to cope with the increasing pressures of advancing technology, we need to avoid emotionalism and approach the issue of the role of technology in education in a logical and systematic fashion. Basically, technology must be a part of the total educational system. We need to evaluate this technology based on the degree to which it increases student performance and allows teachers to accomplish the schools' goals with their limited resources. Implied in this evaluation framework is the need for a systematic approach to educational planning. For unless we have a clear focus on what we are trying to do, and why, all the technology in the world will not help us achieve quality(Scanlon, 1979).

Computer Awareness

> Computers . . . touch all aspects of lives of children and adults but they have yet to break down barriers of the classroom(Trump, 1980)

The impact of computers on society has been and will continue to be revolutionary. The one glaring exception to this generalization is found in education, where this tool that we call a computer, which is considered a vital necessity in business, science, and government, has no similar role. Several reasons may be given as to why computers in education do not yet have the status of necessity found in other segments of society. Some say that computer awareness programs in schools, for example, are an unnecessary frill and such awareness is the individual's responsibility outside of school(Molnar, 1978). However, since computer uses are expanding at an accelerating rate, the day is fast approaching when adults who are not computer literate will b e at a distinct disadvantage, for without awareness and literacy first, people cannot know how to use computers or to evaluate their impact. Since children learn to use computers easily and quickly because they do not have the adult's fear of them(Gottschalk, 1980), it seems appropriate for schools to be involved in the teaching of computer literacy. Furthermore, a student who graduates in 1980 and beyond without being exposed to computers has had an incomplete education. Of even greater concern is that retraining after graduation, even though acceptable in principle, reflects unnecessary human waste at an unacceptable cost in social and psychological terms to the individual(Molnar, 1978).

Computer education today rides the horns of a dilemma. In an almost Catch-22 fashion, we have, on the one hand the golden opportunity to exercise

the leadership necessary to develop computer-based education(Aiken and Braun, 1980), but on the other hand, the foremost obstacles to the implementation of instructional computing in our schools are untrained teachers and administrators who are virtually illiterate about the nature of computers and their use(Edwards, 1980). As a result of the apparent lack of leadership among educators, school administrators are reluctant to spend money on computer training, and, therefore, the task is being handed over to the business world without a challenge from educators (Computer Illiteracy cited, 1980).

The obvious immediate result of decisions being made by unaware and untrained teachers and administrators is seen in current microcomputer purchases. Many schools are currently buying microprocessors without being certain what to do with them because the ability of these educators to evaluate and use these machines has not, according to Aiken and Braun (1980), kept pace with the technological advancements.

If we as educators are to accept a meaningful leadership role in computer based education, then, first and foremost, we need to develop some kind of consistency in the training of teachers and administrators to become computer literate first and trained in the use of computers second. Only when administrators and teachers acquire a basic understanding of computers and their implementation and use in education will they be able to make rational decisions relative to the educational well-being of our youth(Henderson, 1978).

A way, the preferred way at this point, to develop informed educators can begin with pre- and in-service training in computer awareness. Computer awareness is generally taken to mean the possession of enough knowledge to

be able to make social and general inferences about computers. While the knowledge gained through a computer awareness program will not equp an individual to deal with any situations to the extent of a computer professional, it will equip that individual to deal with situations involving computers with the same facility as he/she now deals with general situations (Makkar, 1976). It is exactly this kind of general knowledge that most of today's teachers and administrators appear to be lacking. Four objectives are seen as minimal for a computer awareness program for all:

1. To reduce bewilderment about computers in the minds of individuals and to promote a balanced view of the computer's role in society.

2. To enable people to use and influence the design of computer-based social services with confidence.

3. To enable people to work in a computer environment without major difficulties.

4. To develop informed opinions to influence decisions regarding computer applications which have political and educational implications (Makkar, 1976).

Matching Instruction and Learner Objectives

The use of computers in instruction has been an option available to schools for approximately two decased and has been a cost-effective option for almost five years. It should no longer be the case, therefore, that computers are a novelty to educators or students. We, as educators, can no longer depend upon a Hawthorne effect or the novelty of the machine to motivate the learners. The teacher, as always, has the responsibility to plan instruction based on the intended outcomes of the curriculum, that is, on the basis of what to teach and then to consider to whom. Within this

design, the tools and media are of secondary importance rather than primary (Nievergelt, 1980).

Many now believe that given the current and forecast technologies, we do have a unique learning tool available to us in the computer. Bork and Franklin(1979), for example, defended the unique characteristics of the computer when they said that "The computer is the first technological innovation in education that enables us to start moving back, even with a large number of learners, to a situation like that of Socartes where the educators can respond fully to each individual learner."

One valuable result of the introduction of computers has been that in order to use computers effectively, educators have had to consider curriculum and instruction in a systematic manner. The development of an instructional sequence, for example, begins with a review of instructional alternatives. Following this review, a decision must be made to select the most effective strategies for instruction, and then the instructional strategies must be designed in order to achieve optimum motivation(Pratt, 1980). If we, as educators accept this or any other similar systematic approach to instruction, then whether or not to use computers becomes a rational decision and not an emotional and indefensible one. If we are to use this aid called a computer, however powerful, to help with instruction in a rational manner, then we need a commitment from today's educators to examine the use of computers to help meet the needs of individual learners(Bork and Franklin, 1979).

The uniqueness of the computer as an interactive and responsive tool makes it an effective educational aid in instructional systems. While computers can be an aid in matching educational programs to student needs, they should rarely be advocated as an exclusive learning environment(Aiken and Braun, 1980).

Apparently, if judgments are made by today's relatively limited uses of computers in education, it appears that computers will not be used as an instructional tool until teachers believe that computers can be an asset and until they have positive attitudes toward them(Stevens, 1980). These positive attitudes appear necessary. When assessing the components of a successful learning environment, one prevailing theme arises and that is that the ingredient of greatest importance in any positive learning environment is a capable, interested teacher(Aiken and Braun, 1980). Learning environments involving computers are no different, for here too a knowledgeable and interested human organization is necessary for success, because if teachers and administrators are unwilling to support computers as an instructional aid, then assuredly this scheme will not succeed (Nievergelt, 1980).

Several causes for the current, relatively weak, state-of-the-art of computer based education are readily apparent. Most of these reasons are found in the human component of the instructional system, and one generalization concerns teacher behavior. Teachers are generally conservative in nature and their inexperience with computers causes them to avoid extensive use of them(McIsaac, 1979). Another reason is found in our learned behaviour toward computers. The word "computer" appears to block rational thought in many people. In this vein, the term "computer-assisted instruction" places unnecessary emphasis on the word "computer." We hardly ever say "chalkboard-assisted instruction" or "textbook-assisted instruction" (Nieve-gelt, 1980), and it somehow seems detrimental to the development of instructional systems to emphasize "computer" when "instruction" is our goal.

Paradigms for Teacher Training

Through the developmental period of computer-based education in the

Sixties and Seventies, a valid and often-used reason for the slow influx of computers into our schools was that educators knew very little about computers. Milner(1980) reports that even today educators know very little about computers because they have had no training in their use. Very few universities offer any training for teachers because, very simply, no demand has been shown.

Demand for training in the effective use of computers appears to be at hand. With computers within the economical reach of almost everyone, the time is now for schools to examine their role in the computer education of our society. Courses and programs for pre-service as well as in-service teachers need to be developed on a widespread basis. Unless teachers acquire some basics of computer literacy, all of our attempts to use computers in our instruction will be wasted(Aiken and Braun, 1980).

In order to reach the simple objectives of computer literacy for all, teachers will have to understand that computers can help in the instructional process; they will have to acquire the appropriate skills(including some basic programming skills); they will have to have access to computer facilities; and they will have to be aware of the strengths and weaknesses of computer-based education(Stevens, 1980).

Several models for teacher training in computer use have been proposed recently. The question generally raised focuses on how much should a teacher know about computers in education(Milner, 1980). Rather than attempting to answer a virtually unanswerable question, it appears more relevant to examine teacher needs in terms of student needs and develop a program from this point of view. Following this logic, the needs for a teacher training program in computer awareness can be justified:

1. As they deal with children, teachers will be faced with questions about computers and their effect on the environment, on information processing, and on the course of study.

2. The educational system increasingly depends on computers for its administration.

3. All teachers will have computing resources at their disposal (Syllabuses, 1980).

Such innocuous needs belie their importance and their ramifications for education. If we accept these as valid needs, then to satisfy them, a course of study for teachers must have as its aims the provision of a foundation for more specific study of educational computing and the installation of awareness of the capabilities, limitations, and social implications of computers. These rather limited aims could very easily be met in a one-day workshop of five to six hours duration. The cover sheet of the course syllabus might appear like this:

Computer Awareness Workshop

Rationale: (1) As they deal with children, teachers will be faced with questions about computers and their effect on the environment, on information processing, and on the course of study. (2) The educational system increasingly depends on computers for its administration. (3) All teachers will have computing resources at their disposal.

Objectives: (1) To reduce confusion about computers in the minds of individuals, and to promote a balanced view of the computer's role in society. (2) To develop informed opinions in order to influence decisions regarding computer applications which have social and educational implications.

Topics:

1. Information

   A. Information Systems

      1) Definition and examples

      2) Using a Computer

      3) School Records - an example

   B. Information Collection and Retrieval

      1) Information and Data

      2) The Nature of Data

      3) Collecting Data

      4) Data Structures

      5) Automatic Data Retrieval and Databases

      6) Data Security

2. Computers

   A. Communications with a Computer

      1) Developments in Man/Computer Communications

      2) Programming

      3) Compilations

      4) Errors

      5) Recend Developments

   B. Computers in the Marketplace

      1) Computing Resources

      2) Tasks for Computers

      3) Automation

      4) Data Processing

      5) Information Technology

C. Computers in Education

1) Teaching With and not just About Computers

2) Computer Assisted Learning

3) Computer Managed Learning

4) Computer Scheduling

5) Computer Guidance(Syllabuses, 1980)

Following such a seminar or workshop as outlined above, which will begin to solve the computer illiteracy problem among teachers and student teachers, the next logical step is to offer programs of study aimed at giving teachers enough knowledge and skills to effectively use computers as an aid in instruction. Some authors see this as a long and rigorous process requiring several college courses. Milner(1980), for example, suggests separate courses in instructional design, designing computer-based learning materials, programming, hardware and software organization, computer uses in education, and computers and society. While such a program may lead to the development of computer specialists, a less extensive program can be developed to help teachers to effectively use computers. Teachers can be moved past the awareness stage and into a minimally operational stage in a three hour college credit course or its equivalent. Such a course in addition to the awareness workshop described above will enable teachers to acquire those competencies necessary to build, use, and/or evaluate computer related materials for instruction. In order to acquire these competencies, the following topics and objectives are offered:

1. The Automatic Control of Processes (to gain a basic understanding of the underlying principles of automation)

2. The Concept of Input-Process-Output (to gain an appreciation of the need for an orderly process in preparing, entering, storing, retrieving, and interpreting data).

3. Coding Systems (to gain an operational awareness of the need for precise codes and rules when transforming data).

4. Preparation of Input and Interpretation of Output (to gain experience in preparing data for processing and in using output for decision-making).

5. Uning Computer Program Packages (to gain experience in designing, programming, using, documenting, and evaluating both published and teacher-make programs).

6. Hardware and Software in Context (to gain basic knowledge necessary to evaluate computer components, including hardware and software, based on their intended uses) (Syllabuses, 1980).

A course of study such as this will take the teachers beyond the awareness stage and give them practical experience at designing, writing, and evaluating simple instructional programs. The objectives of the course can be reached in a straightforward and painless manner, and the teacher students can leave with a feeling of accomplishment and a level of competence that will enable them to achieve basic literacy and to effectively use computers in their classroom.

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